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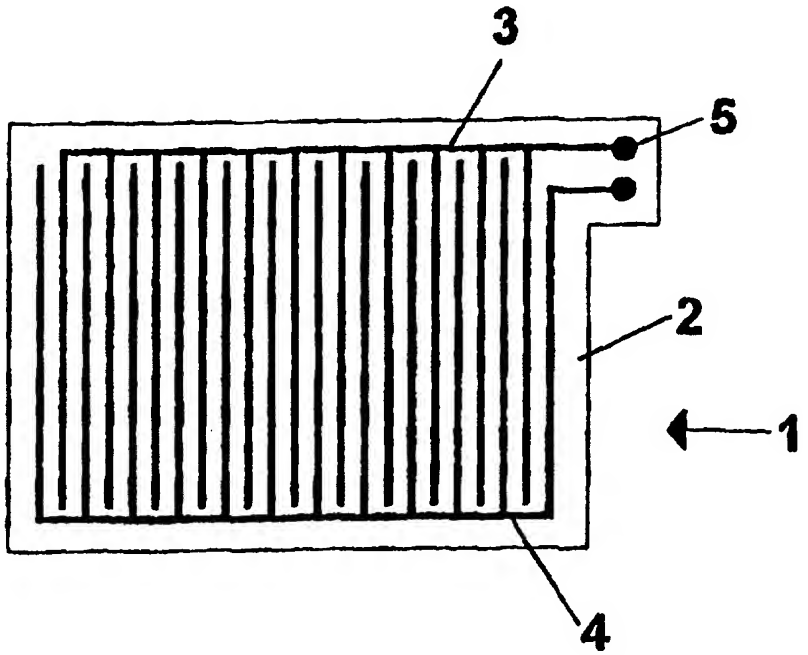
(54) Title: A TRANSDUCER PAD COMPRISING A SENSOR FOR DETECTING ENURESIS NOCTURNA, SHEETS COMPRISING THE TRANSDUCER PAD, METHODS OF PRODUCING THE TRANSDUCER PAD AND THE SHEETS, AND USE THEREOF

(57) Abstract

A transducer pad for detecting enuresis nocturna (incontinence of urine) may be connected to an alarm (11), comprising a sensor (2) which, according to the invention, is made as a disposable item consisting of a non–woven material (8) having printed thereon two conductor paths. The transducer pad (2) may be constructed as part of a sheet, a diaper, briefs or a sanitary towel.



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# A transducer pad comprising a sensor for detecting enuresis nocturna, sheets comprising the transducer pad, methods of producing the transducer pad and the sheets, and use thereof

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The invention relates to a sensor for detecting enuresis nocturna and comprising a transducer pad having applied thereon a conductor pattern with two current paths adapted to be connected to an alarm which emits a signal when the current paths are short-circuited because of occurrence of urine on the transducer pad.

The invention moreover relates to sheets comprising a transducer pad, methods of producing the transducer pad and the sheets, and use thereof.

The condition enuresis nocturna (incontinence of urine) is a condition which occurs in children as well as adults.

Enuresis nocturna is an extremely unpleasant condition particularly for children and may especially have psychical consequences. Thus, children suffering from enuresis nocturna will frequently be cut off from sleeping the night with other children, as they are ashamed at being unable to avoid wetting the bed. It also involves some "trouble" for the parents of the children, since very frequent cleaning of the bed in which the child lies is necessary.

Treatment of children suffering from enuresis nocturna has been found to be most effective if a so-called conditioning apparatus is used, said apparatus being adapted such that when the child involuntarily wets the bed, an alarm will be given immediately. The child wakes up and

is warned that it is time going to the bathroom. The conditioning apparatus consists of a transducer pad which has two electrical conductor paths provided on a sheet-like blanket which is connected to an alarm device. When the two conductors on the transducer pad are short-circuited because of the detection of urine, the conductors will be short-circuited, and an alarm will be given.

Such an apparatus is known e.g. from the published British Patent Application No. 2 228 815 A. This known device comprises a sensor in the form of two separate electrical conductors which are printed on a water-repellent plastics material. Optionally, a cloth may be positioned between the patient and the water-repellent plastics material so that the patient to be treated will find it less uncomfortable lying on this substrate.

It is evident that each time the transducer pad of the known device has detected urine, the transducer pad has to be cleaned. In addition, one cannot rule out the possibility that some patients will sweat when they lie on a water-repellent substrate and, in some cases, may develop an eczema-like condition that may be extremely unpleasant.

Thus, there is a need for providing a transducer pad which comprises a sensor which is more comfortable, and which does not require cleaning each time urine is detected.

In other words, there is a need for developing a transducer pad which may be replaced by a new one each time urine has been detected.

Accordingly, an object of the invention is to provide a transducer pad for detecting enuresis nocturna which is more comfortable and hygienic.

The object of the invention is achieved by a transducer pad of the type stated in the introductory portion of claim 1, which is characterized in that the transducer pad consists of a liquid-absorbing material on whose surface the conductor pattern has been applied by a printing method.

This provides a transducer pad which is not uncomfortable for the patients to lie on, and is moreover inexpensive to produce. It has furthermore been found that the use of a liquid-absorbing material greatly prevents false alarms that may occur if the patient sweats.

Expediently, as stated in claim 2, the water-absorbing material is formed by a non-woven material which has been found to be extremely suitable for use in connection with the printing of conductor paths.

When, as stated in claims 3 and 4, the conductor pattern is a conductive paste, such as a silver paste, optionally dissolved with a 50% diluent, it is ensured that the transducer pad may be adapted to various alarm systems, as the conductivity of the conductor paths may be adapted precisely to the sensitivity range of an alarm system. This also results in a saving in the production, since the amount of silver paste may be reduced.

As mentioned, the invention also relates to a sheet comprising a sensor having a transducer pad.

This sheet is characterized in that the sheet consists of

- the transducer pad with the conductor pattern which is formed by a non-woven material

- a plastics substrate engaging the side of the transducer pad on which the conductor pattern has been printed.

This provides a sheet which may be produced as a disposable item which may be placed directly on a mattress, and the patient may be placed directly on top of the sheet. Further, an extremely stable substrate which does not crease, is provided hereby.

In an alternative embodiment, the sheet may be produced as defined more fully in claim 8.

As mentioned, the invention also relates to a method of producing a transducer pad having a conductor pattern for use in the detection of enuresis nocturna. This method comprises the steps of:

- cutting a non-woven material to a desired length

- making a printing frame with a template which is provided with the conductor pattern

- applying a conductive paste, such as a silver paste, to the printing frame

- printing the paste on the non-woven material.

This method makes it possible to produce transducer pads in all possible sizes in a simple manner, as needed.

Further, the invention relates to a method of producing a sheet. This method is characterized by comprising the steps of:

- cutting a non-woven material to a desired length
- making a printing frame with a template which is provided with the conductor pattern
- applying a conductive paste, such as a silver paste, to the printing frame
- printing the paste on the non-woven material
- heating the transducer pad for 1-15 minutes by conveyance through a heating tunnel which has a temperature of about 120 °C
- attaching a liquid-repellent layer, such as a plastics substrate, to the side of the non-woven material on which the conductor pattern has not been printed
- bending and gluing the liquid-repellent layer along an edge of the side of the non-woven material on which paste has not been printed.

In an alternative embodiment, the sheet may be produced by a method as defined more fully in claim 12.

Finally, the invention relates to a use of a transducer pad.

This use is defined more fully in claim 15.

The use may very well be implemented in practice with the same method as in the production of the transducer pad in connection with the previously mentioned sheets.

Expedient embodiments of the invention are defined in the dependent claims.

The invention will now be explained more fully with reference to an embodiment shown in the drawing, in which

fig. 1 is a schematic view of the transducer pad according to the invention,

fig. 2 is an enlarged view of the printing of the conductor pattern on the transducer pad according to the invention,

fig. 3 is a schematic view of a sheet with the transducer pad according to the invention,

fig. 4 is an extruded, schematic view of the structure of the sheet of fig 3,

fig. 5 is an enlarged view of contact points on the transducer pad according to the invention,

fig. 6 is a schematic view of an alarm device for use in connection with the transducer pad and the sheet according to the invention,

fig. 7 is a schematic view of the structure of a sheet with the transducer pad and a plastics substrate in an alternative embodiment of the invention,

fig. 8 is a schematic view of a sanitary towel with a plastics substrate according to the invention,

fig. 9 is a schematic view of a variant of the embodiment of fig. 8, and

fig. 10 shows a patient in a bed provided with a transducer pad according to the invention.

In fig. 1, the transducer pad of the invention is generally designated by 1. The transducer pad 1 consists of a non-woven material 2, which is a water-absorbing material. This material is provided with two conductor paths 3, 4 which have been applied by means of a pressure treatment. The two conductor paths terminate in two contact points 5, which are intended to be connected to an alarm (not shown). The mode of operation of the transducer pad is such that when liquid touches the non-woven material 2, a short-circuit will take place between the conductor paths 4, 5 which can be detected by an alarm.

Fig. 2 shows a fraction of the transducer pad 1 in somewhat enlarged view. It also appears from the figure that the conductor path, here in the form of paste 6, is printed almost through the non-woven material. In other words, the silver paste is sucked down into the non-woven material, which means that it will not break after solidification.

The production of the transducer pad shown in figs. 1 and 2 is carried out in the following manner:

First, the non-woven material is cut to a desired length, depending on the use. This use may e.g. be in connection with the production of a sheet which is placed on a bed, or e.g. for the production of a pair of briefs, a sanitary towel or a diaper, where it is needed to detect onset of urination. Then a printing frame is produced, with

a template having the shape of the conductor pattern to be applied to the non-woven material. Conductive paste, e.g. silver paste, is now applied to the template in the printing frame. Expediently, the silver paste is diluted in a suitable manner, so that the electrical resistance in the silver paste may be varied for use in the adaptation to various alarm connections, which may have various sensitivity ranges. It is so that the more sensitive the alarm device is, the less resistance is required in the silver paste, which provides the advantage that less silver paste may be used in more sensitive devices, thereby achieving cost savings in the production of transducer pads. Printing is performed after the application of the silver paste, and the entire transducer pad is fed into a heating tunnel, which has a temperature of about 120 °C, for about 1-15 minutes.

It is thus a very quick and simple process for the production of transducer pads, which, of course, is a prerequisite for using these as disposable items.

Fig. 3 shows a first embodiment of the use of the transducer pad according to the invention. In fig. 7, the numeral 7 designates a sheet on whose surface the transducer pad 2 is arranged with its conductor paths 3, 4 and contact points 5. The sheet, cf. fig. 4, is constructed as a laminate consisting of four layers. In fig. 4, the upper layer 2 is the transducer pad itself shown in fig. 3. This layer is arranged such that the printing side faces downwards toward a layer 8, which is a very thin non-woven material which retains the liquid-absorbing layer 9 which is constructed in the same manner as a conventional diaper. Finally, the numeral 10 designates a water-repellent layer which may e.g. consist of a thin non-woven film of e.g. polyethylene. The four layers may be attached to each other by means of various known tech-

niques, such as by gluing with strips of glue, spot gluing, welding, ultrasonic heat welding, single stitching, Velcro closure, etc.

Motifs attractive to children, such as bears, aircraft, cartoon characters, idols and the like, may also be printed on the sheet, so that it does not have a too sterile appearance.

Fig. 5 shows in enlarged view an example of how the contact points 5 on the transducer pad may be shaped. As will be seen in fig. 5, the contact points 5 are shaped as push-buttons, which may be connected to e.g. wires (not shown) which are connected to corresponding push-buttons in the alarm 11, which is shown schematically in fig. 6, and which also has push-buttons 12. The alarm 11 may be of widely different type. It is merely to be adapted so as to be able to detect that a short-circuit takes place between two conductors, and, if so, to give an alarm.

Examples of the possible settings and connections of an alarm which are particularly suitable in connection with the transducer pad of the invention, include the following ones:

a) automatic sensitivity regulation of the alarm to prevent false alarms because of perspiration

b) emission of various alarm sounds so that the sounds may be adapted to the individual patient

c) connection of a vibrator for use by deaf patients

d) connection of a radio transmitter for use in connection with monitoring from another room than the one in which the patient is present

e) connection of earphones, which is important inter alia if several persons are present in the same room.

Fig. 7 shows another way of making the sheet with the transducer pad. As will be seen from the top in the figure, it consists of a transducer pad 1 with silver print prior to lamination with a liquid-repellent material. The transducer pad consists of a single layer of non-woven material whose side with silver print, see the bottom of fig. 7, is placed against a plastics substrate which is bent to form edges 5 and 14 which are secured to the rear side 13 of the transducer pad e.g. by gluing. The figure moreover shows an alarm 11 which is connected via wires to connection points close to the edges 5 and 14. This provides a sheet which, because of the edges 5, 14, to a great extent prevents liquid from flowing over the edges 5, 14. Further, a sheet is provided which is extremely strong and stable, and which does not slide or crease easily on the bed.

To ensure that the sheet is well supported on a bed, the rear side of the sheet may be formed with a self-adhesive material, which, however, does not prevent easy change of the sheet.

Fig. 8 shows a sanitary towel which is constructed like the sheet of fig. 7, with the rear side 13 of the transducer pad placed in a plastics substrate with bent edges.

Fig. 9 shows a variant of the embodiment of fig. 8 with connection coils 18 for attachment of an alarm. The nu-

meral 21 designates a bent edge which prevents liquid from running out of the sheet. The non-woven material 20 may e.g. consist of a high-absorbing liquid-sucking material which may be composed of two layers of non-woven material 21, a high-sucking dry powder (not shown) being interposed between the layers. This results in an extremely high suction power and is pleasant to lie on. The sheet shown in fig. 9 may be produced by applying an electrode of a suitable size on one side of the non-woven material, said electrode being then covered by a water barrier 20 which is bent as shown at 21.

Finally, fig. 10 shows a patient 18 placed on a bed which is equipped with a sheet according to the invention.

Patent Claims:

1. A transducer pad (1) comprising detection of enuresis nocturna and having applied thereon a conductor pattern (3, 4) with two current paths adapted to be connected to an alarm (11), which emits a signal when the current paths are short-circuited because of occurrence of urine on the transducer pad, characterized in that the transducer pad (1) consists of a liquid-absorbing material (2) on whose surface the conductor pattern has been applied by a printing method.

2. A transducer pad according to claim 1, characterized in that the water-absorbing material (2) is formed by a non-woven material.

3. A transducer pad according to claim 1 or 2, characterized in that the conductor pattern is a conductive paste (6), such as a silver paste.

4. A transducer pad according to claim 3, characterized in that the silver paste (6) is dissolved with a 50% diluent.

5. A transducer pad according to claims 1-4, characterized in that the transducer pad is a disposable item, which is exchanged each time the alarm has been activated.

6. A sheet comprising a transducer pad according to any one of claims 1-5, characterized in that the sheet consists of

- the transducer pad (1) with the conductor pattern which is formed by a non-woven material

- a plastics substrate which engages the side of the transducer pad on which the conductor pattern has been printed.

7. A sheet according to claim 6, c h a r a c t e r i z e d in that the plastics substrate is bent so as to form an edge on the side of the transducer pad which is opposite to the side on which the conductor pattern has been printed.

8. A sheet comprising a sensor according to any one of claims 1-5, c h a r a c t e r i z e d in that the sheet consists of a laminate of the following four layers:

- the transducer pad (1) with the conductor pattern

- a thin non-woven material (8) whose one side faces toward the side of the transducer pad on which the conductor pattern has been printed

- a liquid-absorbing material (9) whose one side engages the other side of the thin non-woven material, and

- a liquid-repellent layer (10) which engages the other side of the liquid-absorbing layer.

9. A method of producing a transducer pad (1) with a conductor pattern for use in the detection of enuresis nocturna and comprising the steps of:

- cutting a non-woven material (2) to a desired length

- making a printing frame with a template which is provided with the conductor pattern

- applying a conductive paste (6), such as a silver paste, to the printing frame

- printing the paste (6) on the non-woven material.

10. A method according to claim 9, c h a r a c t e r - i z e d in that the silver paste (6) is diluted prior to application.

11. A method according to claims 9-10, c h a r a c - t e r i z e d in that, after printing, the transducer pad (1) is conveyed through a heating tunnel in an oven, which has a temperature of about 120 °C, for between 1 and 15 minutes.

12. A method of producing a sheet with a conductor pattern for use in the detection of enuresis nocturna and comprising the steps of:

- cutting a non-woven material (2) to a desired length

- making a printing frame with a template which is provided with the conductor pattern

- applying a conductive paste (6), such as a silver paste, to the printing frame

- printing the paste (6) on the non-woven material

- heating the transducer pad for 1-15 minutes by conveyance through a heating tunnel which has a temperature of about 120 °C

- attaching a liquid-repellent layer, such as a plastics substrate, to the side of the non-woven material on which the conductor pattern has not been printed

- bending and gluing the liquid-repellent layer along an edge of the side of the non-woven material on which paste has not been printed.

13. A method of producing a sheet according to claim 8, c h a r a c t e r i z e d by comprising the steps of:

- cutting a non-woven material (2) to a desired length

- making a printing frame with a template which is provided with the conductor pattern

- applying a conductive paste (6), such as a silver paste, to the printing frame

- printing the paste (6) on the non-woven material

- heating the transducer pad for 1-15 minutes by conveyance through a heating tunnel which has a temperature of about 120 °C

- attaching a thin non-woven material to the side of the transducer pad on which the paste has been applied

- attaching one side of a liquid-absorbing material to other side of the thin non-woven material

- attaching a liquid-repellent material to the other side of the water-absorbing material.

14. A method according to claim 13, c h a r a c t e r - i z e d in that the attachment is performed by gluing, by ultra-sound, heat-welding, stitching, by Velcro-closure or similar methods.

15. Use of a transducer pad according to any one of the preceding claims in connection with a diaper, disposable briefs, a disposable sanitary towel or a disposable sheet.

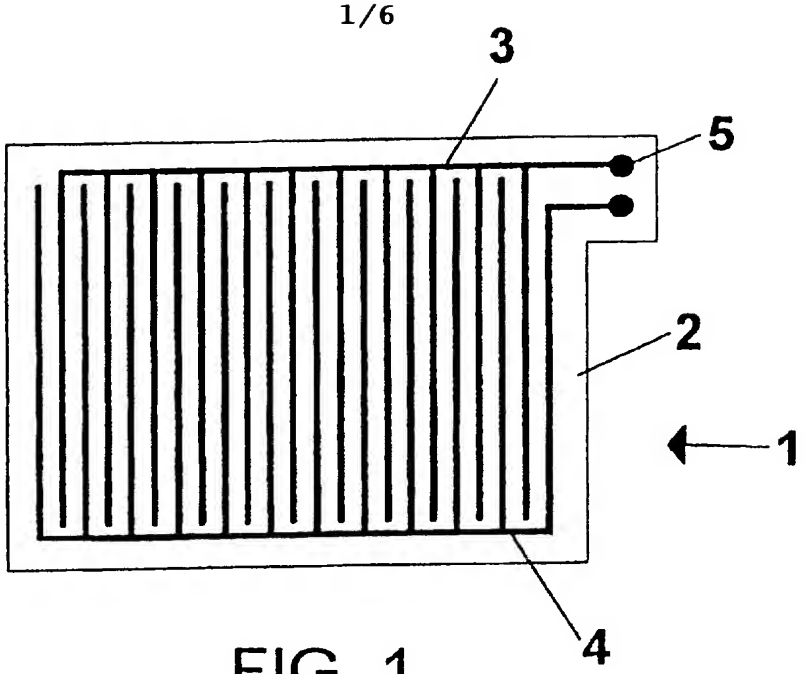


FIG. 1

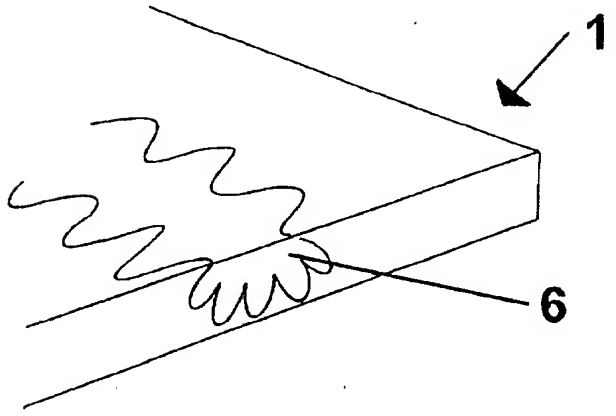


FIG. 2

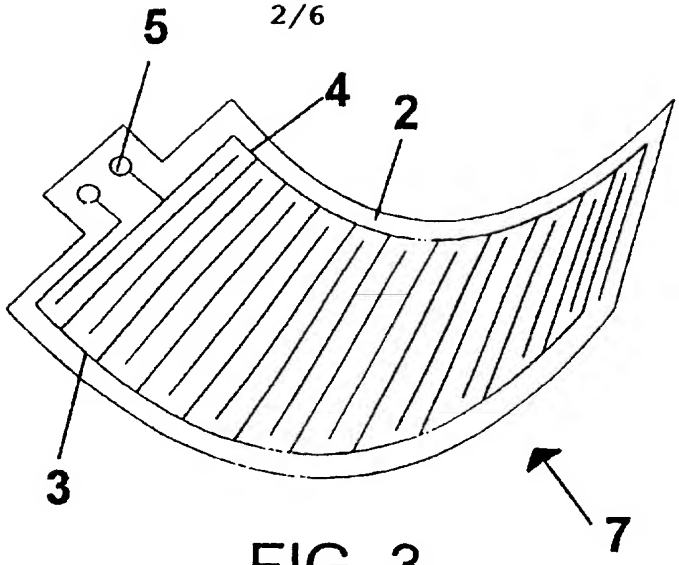


FIG. 3

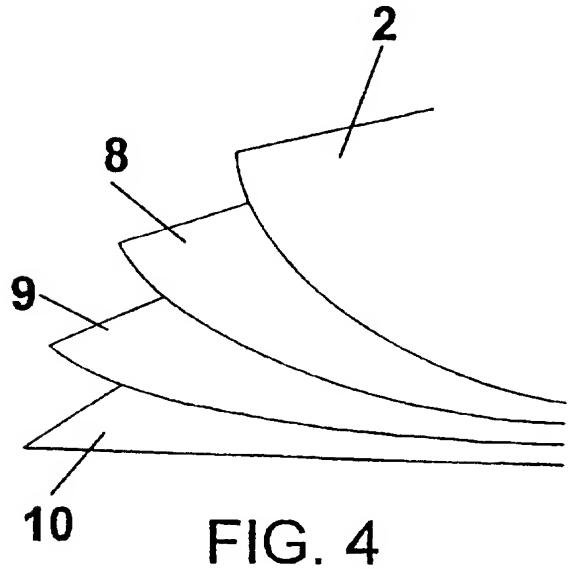


FIG. 4

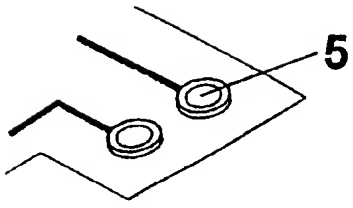


FIG. 5

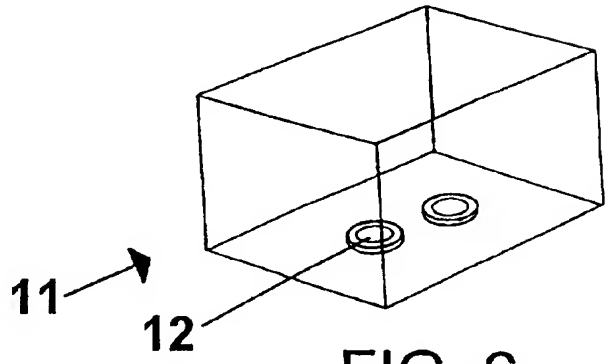


FIG. 6

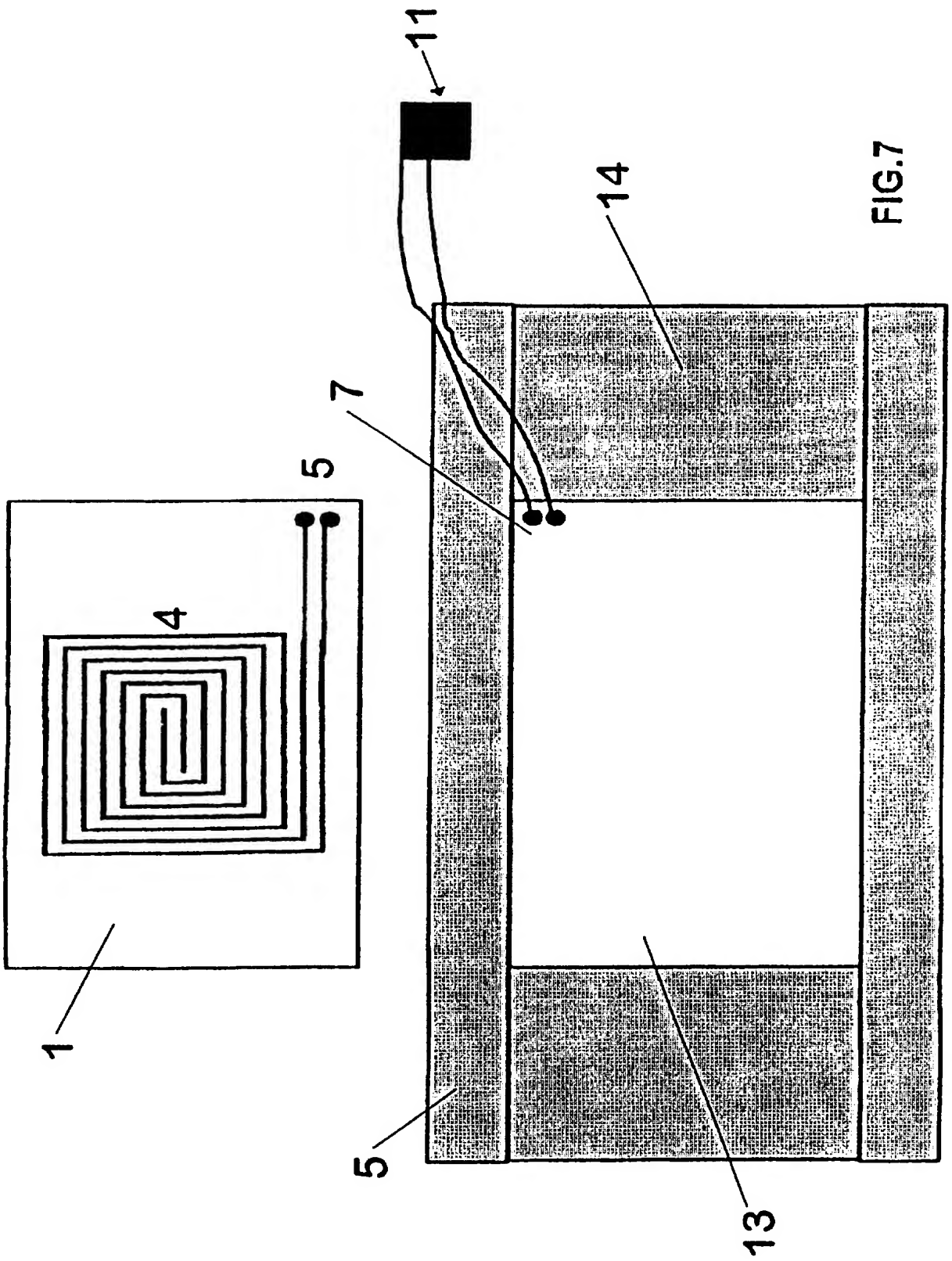


FIG.7

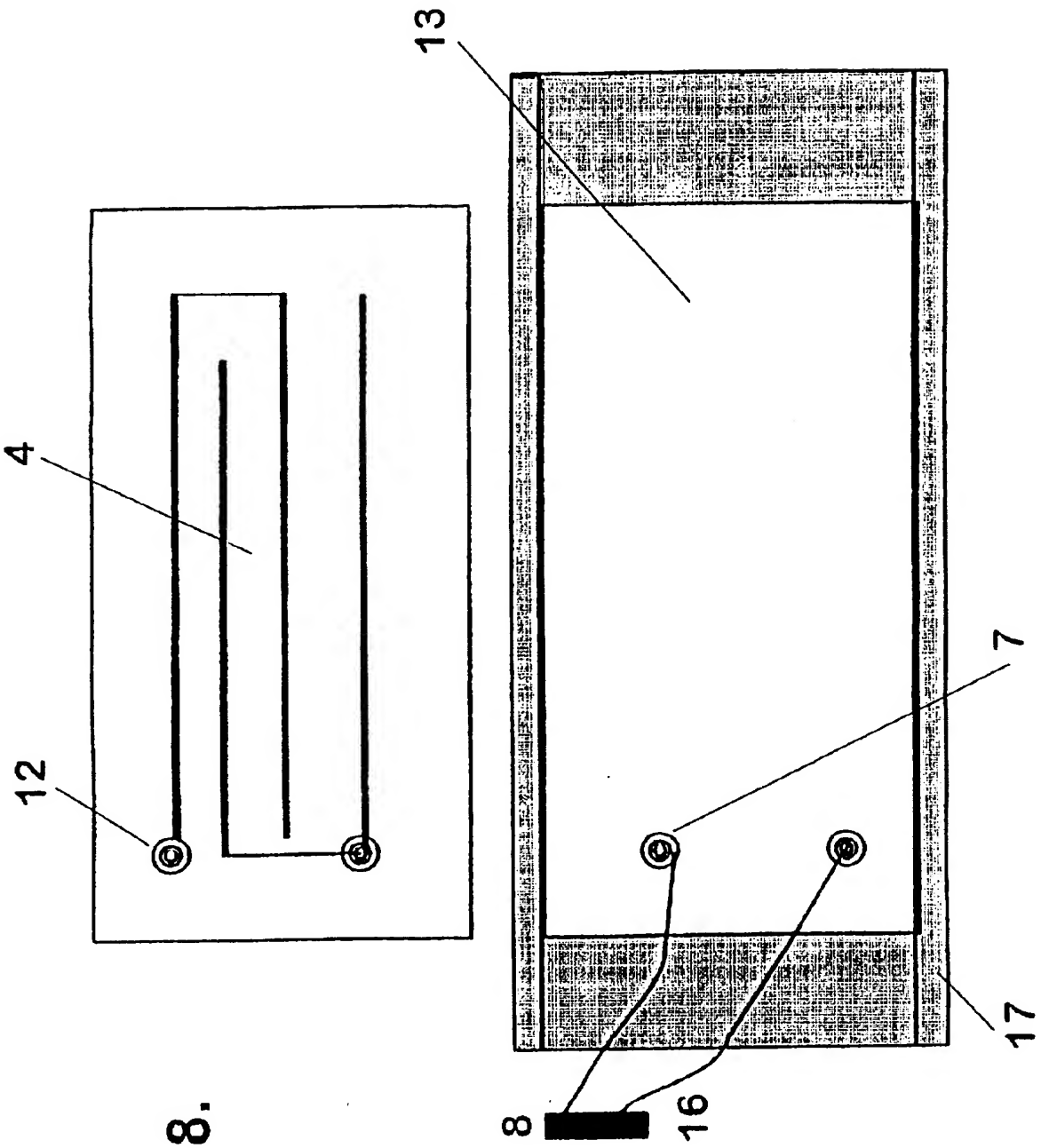


FIG. 8.

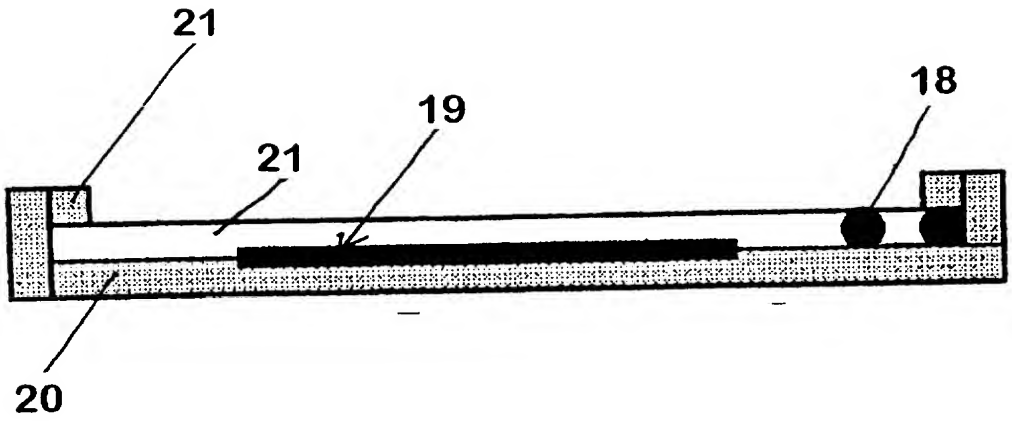


FIG. 9

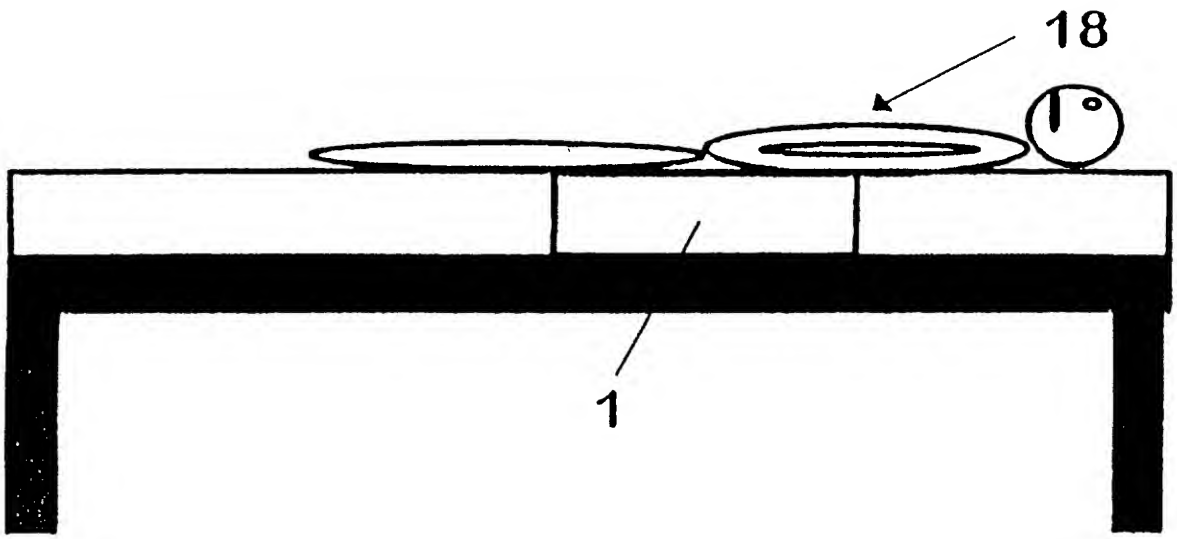


FIG. 10

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 97/00406

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A61F 5/48, A61F 13/42
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | WO 9620681 A1 (GERSTENZANG, WILLIAM, C), 11 July 1996 (11.07.96), page 11, line 21 - line 27; page 12, line 15 - line 20; page 15, line 3 - line 6, figure 4A<br>-- | 1-4,6-15 |
| X | US 4539559 A (HUGH KELLY ET AL), 3 Sept 1985 (03.09.85), column 2, line 22 - line 27<br>--<br>-------- | 1-2,5,15 |

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Information on patent family members

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